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Supporting people to implement a reduced carbohydrate diet: a qualitative study in family practice

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ABSTRACT

Introduction Much of the science behind dietary guidelines for risk reduction and chronic disease management is equivocal, and there are well-accepted uncertainties and complexities relating to diet in everyday life, as well as physiological processes. Guidelines have therefore stopped short of aligning with one particular approach, instead highlighting several evidence-based options. However, reduced carbohydrate, or 'low-carb', diets have increasing traction in the media and with patients, practitioners and the general public. This qualitative study examines healthcare practitioner (HCP) experiences of implementing a reduced carbohydrate diet.

Methods Semistructured, qualitative interviews were conducted with 19 HCPs in the UK family practice (including general practitioners, practice nurses and non-medical practitioners), recruited through a special interest forum, and social media. Data analysis employed social science theory and methods to produce key themes.

Results All participants self-identified as 'low-carb practitioners' who, over time, had introduced a specific focus around carbohydrate reduction into their work. They reported transformations in patients' metabolic markers, patient enthusiasm for the approach and renewed job satisfaction. Key themes highlight experiences of: (1) discovering low-carb as a new 'tool-in-the-box'; (2) promoting and supporting incremental low-carb experimentation; and (3) diverging from established dietary guidelines.

Conclusions This study provides important experience-based evidence on a topical dietary intervention. Participants strongly advocated for the use of low-carb diets. The successes described draw attention to the need for pragmatic, formative evaluation of low-carb advice and support as a 'complex intervention' (alongside physiological research), to justify, challenge and/or shape low-carb intervention in clinical practice. The findings raise important questions about the contribution of particular *care practices* to the apparent success of low-carb. Social science analyses can elucidate how dietary intervention is carried out across different healthcare settings (eg, dietetics, endocrinology) and patient groups, how healthcare practices intersect with people's everyday self-management and how different forms of evidence are invoked and prioritised.

What this paper adds

- Healthcare practitioners in family practice reported that implementing low-carb has transformed many patients' metabolic health—and their own experience of practice.
- Low-carb practitioners were unusually-attentive to patients' diets, adapting models of care to help patients experiment and address tensions between low-carb and dietary guidelines.
- Further research should prioritise pragmatic and formative social-science analyses of low-carb approaches as 'complex interventions' across different healthcare settings and patient groups.

INTRODUCTION

Prior to the advent of pharmacotherapy to manage blood glucose, limiting carbohydrate in the diet was the primary method of managing metabolic disorders, most notably diabetes.[1] Subsequently, pharmacotherapy has taken on a much more prominent role, although modification of diet and lifestyle is still, in principle, a first-line strategy.[2]

Current dietary recommendations promote a person-centred approach, and the same healthy eating advice for people with metabolic conditions (eg, type 2 diabetes) as for the general population[3]: '50% of total dietary energy should be from starchy carbohydrates (such as potatoes, bread and rice), opting for higher fibre or wholegrain versions where possible'.[4] However, since 2011, reduced carbohydrate or 'low-carb' diets, classified as 50–130 g/day,[5] have been recognised in UK guidelines as an option for the management of type 2 diabetes—but remain controversial.[6–8] In response to uncertainties and the increased popularity of this dietary approach, Public Health England commissioned an evidence review by the Scientific Advisory Committee on Nutrition (SACN).[9] The review was published following a joint working exercise (including the British Dietetic Association (BDA), Diabetes UK and others),[9] and concluded that there are 'beneficial effects of lower carbohydrate diets for some outcomes (HbA1c, fasting plasma glucose, serum

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triacylglycerol) in the shorter term which are unclear in the longer term'. Over the long term (12+ months), the review found no differential impact on body weight compared with other dietary approaches; impact over the short term was not considered. The report, currently in draft form, also found no harmful effects of carbohydrate restriction in the short term. However, it raised concerns about the impact of low-carb dietary adjustment on micronutrient, saturated fat and fibre intakes—and compatibility with low-fat, wholegrain approaches, which provide the basis for therapeutic, preventative and population-level 'healthy eating' advice.

The SACN report highlighted limitations, uncertainties and complexities in the evidence base, many of which are endemic to nutrition science, in which practicalities of undertaking dietary research and funding requirements have impeded long-term 'high quality' trials, and professional consensus.[5 10] For example, the report noted: variations in definitions of low-carb and outcomes measured; difficulty in isolating the impact of carbohydrate restriction (specifically) from what could be attributed to weight loss (more generally—and could therefore be achieved with other dietary approaches); lack of studies measuring outcomes beyond >12 months. For these same reasons the BDA has resisted aligning with one particular approach. Instead, it has emphasised that dietary support should be focused on weight loss and orientated to individuals' preferences—following the finding that the 'ideal diet is the one that is best adhered to'.[11] The BDA has reasserted the importance of professional dietitians as 'the only regulated healthcare experts in diet and nutrition, [who] should form an integral part of the multidisciplinary team that cares for people with diabetes'.[7]

There are an increasing number of healthcare practitioners (HCPs) in other clinical fields, especially family practice, *actively promoting* carbohydrate restriction for people with type 2 diabetes and the cluster of other related metabolic conditions that are involved in 'metabolic syndrome'.[12] These HCPs have connected to an international, grass-roots movement of scientists, clinicians and others who, based on their interpretation of the scientific evidence,[13–17] advocate for low-carb and 'very-low-carb'/ketogenic diets (20–50 g/day)—as a 'superior'[18] approach with 'untapped potential'.[19] These advocates have questioned the epidemiological studies on which guidelines such as the Eatwell Guide are based, and drawn attention to the physiological mechanisms involved in the metabolism of dietary components (eg, carbohydrate, cholesterol, saturated fats) and problems of insulin resistance and hyperinsulinaemia.[20 21] In the UK, interest in low-carb among HCPs has been spurred by influential general practitioner (GP), David Unwin,[22] who has observed improvements in patients' metabolic markers in individual case reports and retrospective analyses within his family practice.[23]

Qualitative research is important for investigating the dynamics of food-related healthcare interventions—which can be characterised as 'complex interventions'[24] due to their multiple elements and potential mechanisms of action. It is crucial to understand how such complex dietary interventions are undertaken, what they involve, how and why they work and for whom.[25–28] Many such healthcare interventions are developed and adopted in the 'real-world'. This is the case for low-carb intervention, which has evolved as part of grass-roots activity within family practice. A starting point for investigating low-carb intervention is to capture the experiences of stakeholders.[29] This study provides important experience-based evidence[30] asking 'What are HCPs' experiences of employing low-carb intervention in family practice?' With low-carb gaining increasing traction, while the scientific evidence remains equivocal and challenging to interpret,[31] it is crucial to learn from this real-world evidence.

METHODS

This study explores HCPs' experiences of employing low-carb information, advice and support in family practice—the site of most first-line support for people with type 2 diabetes, obesity, hypertension and other related metabolic conditions. The data reported are drawn from a larger scoping study of views and experiences of low-carb interventions, which also included HCPs outside family practice, many of whom had not routinely integrated dietary (low-carb) advice into their professional work. This paper reports only the experiences of *practitioners offering low-carb interventions in family practice*—the main group of respondents.

Participants were recruited via an online special interest forum (200+ UK-based members) and Twitter. As this was an exploratory study, we did not restrict the study to particular HCP roles. Interviews were conducted (with written consent) by the first author, CC, a qualified, experienced social scientist and qualitative researcher, via video or phone during July to August 2020. The topics covered were adapted to the participant, and CC also iteratively drew on past interviews to address emerging areas of interest as the study progressed. Participant accounts were interrogated in detail, and in some cases challenged (drawing on CC's knowledge of scientific debate about low-carb intervention). The focus of interviews was on practitioner experiences and practices, which also included 'shadowed data'—participants discussing the experience of patients.[32] Data collection was completed when the data set was an appropriate size and quality to meet expectations of rigorous qualitative research—taking account of the scope of the study, nature of the topic, quality of the data and study design.[32] In relation to the main findings reported in this study, data saturation was achieved. A topic guide is shown in box 1.

Both data collection and analysis were carried out by CC and drew on social science theory and methods, particularly Smith's mode of enquiry focused on the

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Box 1 Qualitative interview topic guide

Topic guide

- How was the participant introduced to low-carb and why/how are they promoting in practice (or not)?
- What types of low-carb dietary approaches are being promoted? (eg, What constitutes 'low-carb' in practice?).
- Which patient groups are being targeted?
- What rationales are being used as the basis for implementation?
- How are healthcare practitioners (HCPs) promoting and supporting low-carb approaches in practice? (eg, resources, behavioural techniques, organisations involved).
- What are HCPs' experiences of promoting and supporting patients with low-carb? (eg, What successes and/or obstacles have they and their patients experienced?).
- How are HCPs making sense of the science of low-carb and the scientific controversies—personally, and in their interactions with patients and colleagues?
- How does the low-carb approach fit with guidelines, previous practice and colleagues' current practice?

'social organisation' of people's knowledge and practices.[33] This approach is particularly useful to interrogate different *forms of knowledge, everyday practices* and the coordinating *institutional systems* involved; it provides conceptual and methodological tools to foreground *what happens* in practice even when the research is reliant on *interview*, rather than observational, data.[34] In keeping with this approach, interviews (audio recorded and transcribed) tracked HCPs' *knowledgeable practices* in preference to capturing their opinions on contemporary dietary debates. Studies using a similar methodological approach have shown that, when HCPs are questioned about the *practical details of what they do and say* rather than being asked only about their opinions, their accounts align well with both patients' accounts and observations of practice.[35]

Analysis began with writing summary field notes after each interview (noting particular areas of interest), reading transcripts and reviewing recordings (for data immersion and clarification). Types of activity were coded and indexed (presented here as 'themes' but produced within Smith's theoretical approach). Analysis was carried out July to October 2020 and was based on CC's reflective and thoughtful engagement with the data and the analytical process.[36] This included searching for unusual or contradictory evidence across the data set, and presenting/discussing findings with academic colleagues and research participants. NVivo software was used to store transcripts and aid data retrieval and analysis.

Findings reflect the knowledge and experience of low-carb practitioners, *as they articulated them*. As is usual in qualitative research, participants' accounts (reporting how they act, and what they say) have not been verified as factually accurate, and the excerpts provided also include generalisations and simplifications. However, participants' accounts were interrogated and challenged during interview, and examined for consistency. Interview techniques (eg, focusing on practices rather than opinions) were used to minimise the impact of cognitive bias, but this cannot be eliminated. These findings therefore answer questions about practitioners' *knowledge and experiences of low-carb intervention*; further work would be required to elucidate how these accounts align with observations of practice or with the perspectives of patients.

CC had no personal or professional ties with participants, personal experience of low-carb diets or academic/financial conflict of interest. CC consciously reflected on potential biases, seeking out published and popular critique of the low-carb approach throughout the study.

RESULTS

Nineteen interviews were carried out with HCPs in family practice *with experience of delivering low-carb support* (GPs n=13; practice nurses n=3; employed health coaches n=1; 'Volunteer Health Coaches' n=2 (male n=10; female n=9)). The role described here as 'Volunteer Health Coach' was undertaken by unpaid HCPs who had undertaken the Public Health Collaboration's Ambassadors Programme. Most participants had many years of clinical experience. All participants advocated for low-carb as a first-line approach for the treatment of metabolic conditions relating to metabolic syndrome (eg, type 2 diabetes). For this reason, we describe the participant group here as 'low-carb practitioners', even though the extent to which they had integrated low-carb intervention into their work varied.

It is important to note that all the participants in this study were positive about their experience of advising and supporting a low-carb intervention. Despite efforts to recruit HCPs with *negative experiences* of integrating low-carb into their practice, none were forthcoming. CC also observed contemporary debates about low-carb over ~5 years, including following discussion in news/social media. From this we believe that there is unlikely to be a significant residual group of practitioners (with divergent experiences of providing low-carb interventions) who failed to respond to the study invitation. We consider the participant sample to be broadly representative of the experiences of early-adopter low-carb practitioners.

Key findings outlined below highlight low-carb practitioners' perceptions and experiences of: (1) discovering low-carb as a new 'tool-in-the-box'; (2) promoting and supporting incremental low-carb experimentation; and (3) deviating from established dietary guidelines. Illustrative excerpts mapping to these themes are provided in the sections below and in tables 1–3. All interview excerpts are anonymised.

Discovering low-carb as a new 'tool-in-the-box'

Low-carb practitioners talked about having 'discovered' the low-carb approach, and coming to believe in its superiority when compared with other interventions for people

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Table 1 Discovering low-carb as a new 'tool-in-the-box'—interview excerpts

Reference No	Interview excerpt
1.01	*[The patient] came back to see me having gone from an HbA1c of like 90-something, down to 33 I think. And I was like 'oh wow, well done', and he gave me Michael Mosley's book. And that triggered kind of a really obvious connection between food and blood sugar that I hadn't, embarrassingly [considered]. It's just so overlooked, isn't it?* (PN03)
1.02	*I was a lot bigger [12 years ago]. I was about 20 stone then, so I started low-carb […] and lost loads of weight. And I had polycystic ovaries and insulin resistance, and I did it for that reason as well.* (PN16)
1.03	*I spent two years just reading as much as I could, going to conferences, listening to podcasts. So just immersing myself. It was the most exciting thing I've ever done in my career.* (GP17)
1.04	*I've been diabetic lead for the practice for 18 years. I pushed [patients to manage their conditions] but I watched them get worse, I watched 200 diabetics become 400 diabetics, and I didn't do a single thing that made a difference. I didn't reverse a single case of diabetes. Low-fat doesn't work, full stop.* (GP14)
1.05	*Before I came to this, I'd been doing the diabetes clinics for three or four years, and it was all about drugs, and I wasn't that excited about diabetes. […] When patients would ask me 'what shall I eat, doctor?', I'd sort of avoid the conversations, because I didn't have a good answer, apart from 'everything in moderation'.* (GP17)
1.06	*It blew me away, because all the science is there, all of the biochemistry about sugar and how it leads to fat storage everywhere.* (GP04)
1.07	*Before this, I thought there was no way grossly fat people could become slim again. I thought there was no hope, it never worked unless they got their stomach stapled, and even those got fat again. And I also thought there's no way they can come off all their medication when they've been on insulin and so on. [But] you know, people who do this can come off all their medication.* (GP12)
1.08	*I had another patient who is diabetic, or not diabetic anymore—she's in remission. She had non-fatty liver disease as well, and arthritis in her knees. She went for a scan, and [her liver's] completely clear. And the doctor actually said 'this is not possible!' She was like 'yeah, I've done it through diet'. So she's got no fatty-liver anymore, her arthritis has gone in her knees, and her diabetes is in remission. So, and that's just through food—it's amazing.* (PN15)
1.09	*My [GP] partner and I have found that this is a completely and utterly joyful way of doing medicine. We used to joke about our exit plan. […] We now tell people how liberating it is to practice medicine like this. You've got people coming into your room saying 'I can't lose weight', that's a heart-sink, 'I've got chronic pain, irritable bowel, I've got reflux, diabetes I can't control'. Now all of a sudden we have this magnificent tool in the box. It's completely changed our lives as practitioners.* (GP02)

with type 2 diabetes and related metabolic conditions. They used the term 'low-carb' loosely, typically employing widely circulated definitions of 'low-carb' and 'very-low-carb'[5] to guide advice and support towards a daily carbohydrate intake of ~20–130 g although these amounts were not necessarily shared with patients, or measurement advocated.

Most low-carb practitioners in this study had investigated the science behind dietary intervention, and specifically engaged with the low-carb movement through (for example) journal publications, conference talks, social media and podcasts. Some had been introduced to low-carb by a patient (No 1.01) or following their own metabolic conditions (table 1).

Several low-carb practitioners described personal experience of weight loss and other health benefits from low-carb (No 1.02). All had connected into an informal network of professionals using low-carb, and undertaken online research. Although they had some previous understanding of the fundamental physiology involved from medical curricula, the way in which the science was interpreted (in relation to the management of metabolic conditions) was new and, they found, compelling (No 1.03). However, this application of the science was inconsistent with their own prior knowledge, and the advice they had been giving to patients over many years (No 1.04, No 1.05)—providing different insights to those derived solely from epidemiological studies and interventional trials. Scientists and others within the low-carb movement proposed metabolic mechanisms to which the participants in this study had not previously given much attention, but which intuitively 'made sense' (No 1.06). These HCPs had gradually incorporated low-carb into their clinical practice, usually first experimenting with receptive and interested patients, and accumulating a database of their own 'results', of which most kept independent records to sit alongside the publicised successes of pioneers such as David Unwin. They had come to believe low-carb was a superior approach to other potential options, for most patients with metabolic conditions. Local successes built their own enthusiasm to discuss low-carb options with patients (No 1.07).

Low-carb practitioners gave many examples of patients who had made significant changes to their metabolic health markers (and summary statistics/audits from their own practices). Many of these had experienced metabolic inconsistencies for many years but had managed, with low-carb, to improve their lives in ways that were profoundly

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Table 2 Promoting and supporting incremental low-carb experimentation

Reference No	Interview excerpt
2.01	*I give more of a real-food stance to it. It's having whole-foods and not processed-foods—they tend to be the lower carb foods really.* (PN15)
2.02	*I find out where they're starting from. And most people, if you're diabetic, if you're type 2, if you're obese, got fatty liver, high triglycerides etcetera, you're gonna have a high-carb diet. And so when I ask them about what they eat, and it's cereal and toast for breakfast, sandwiches for lunch, pizza for tea, pasta for tea, cakes and biscuits in between, beer. It's quite easy to cut 50% of those carbs out and lose a lot of weight.* (GP04)
2.03	*I'm not asking people to do calorie-restriction, I'm not asking them to starve, I don't want them to be hungry. 'If you feel hungry, eat. Just don't eat bread and potatoes!'* (GP22)
2.04	*On the Weight Watchers programme I'd lost a bit of weight, and then when I switched to [low-carb] I rapidly lost 15 kilograms without trying, and for the first time in my life hunger left me.* (GP24)
2.05	*I ask patients 'what foods do you think spike your blood glucose?'* (HC08)
2.06	*[For weight-loss] 'We need to get you into fat-burning mode, so to do that we have to get insulin down.'* (GP06)
2.07	*So a simple chat about physiology, basic science, that makes sense. And then wow, the effect it has is tremendous.* (GP24)
2.08	*You sow the seeds, hopefully get them on board, agree to give it a try, maybe four weeks later we check an HbA1c—which is far, far quicker than any diabetic clinic would do it, but we're noticing big changes after four weeks. And if you can say to somebody 'look, your blood pressure's better, your HbA1c's dropped from 120 to 80 and it's only four weeks in, that's an astonishing improvement'.* (GP14)
2.09	*It's about [patients] figuring out: how low can they go? what does that do for their blood sugar? I say 'just go away and play detective for a week, here's a blood sugar machine, write down everything […]. Do you want to push it further? If not, OK…* (GP17)

meaningful to them (No 1.08). These successes included 'uncomplicated' patients and those with multiple conditions and extensive psychological/social barriers to making dietary changes. The job satisfaction that these successes afforded led to transformed experiences of clinical practice from constant 'heart-sink' situations to 'joyful' practice (No 1.09). Low-carb practitioners were encouraged by patient successes and the opportunity to use limited resources better.

Promoting and supporting incremental low-carb experimentation

Low-carb practitioners framed low-carb as a new, but sustainable, way of eating—in contrast to high-carbohydrate eating and/or short-term diets for weight loss which were presented as 'disordered' (unhealthy, unnatural or unsustainable). Their advice to patients started with 'real-food' messages, avoiding processed foods such as breakfast cereals (No 2.01) and focusing on carbohydrate *reduction* from what was frequently a very high baseline (No 2.02) (see table 2).

Low-carb practitioners understood the concept of 'real-food' as a useful first step for patients to reduce carbohydrates (often represented as traditional food using whole/intact and diverse ingredients[37]). They felt that these messages were easy to understand, largely uncontroversial in society and avoided conflict with the advice of other healthcare professionals. They described working with patients to support their personal goals especially avoiding intensification of medication, and achieving weight loss. The low-carb way of eating was not presented as overly restrictive, and low-carb practitioners did not usually recommend 'carb counting' by standard definitions,[38] despite often suggesting the elimination of major sources of carbohydrate such as wheat flour, pasta, rice, potatoes. One of ways they presented the benefits of low-carb, they said, was that people would feel good and not have to go hungry (No 2.03, No 2.04). They described using simple physiological explanations to help patients understand and implement the approach (No 2.05, No 2.06, No 2.07). The aim was for meaningful and sustained metabolic improvement, encouraged by tangible metabolic evidence (No 2.08). Patients were routinely encouraged to experiment using blood sugar monitors along with food records (No 2.09).

Low-carb practitioners talked about employing a range of resources, notably sugar infographics demonstrating how carbohydrate-rich foods are broken down into sugar in the body,[39] real food/fake food pictures, insulin roller-coaster illustrations (showing the impact of carbohydrates on blood sugar and insulin levels) and diet sheets with links to online resources. These had often originated with low-carb pioneers (who had freely shared them), while others were created to meet the needs of particular patient demographics. Inspirational case studies (eg, records of patient successes on consulting room walls) were also widely discussed. Many low-carb practitioners initiated discussion of meal planning with patients (eg, in relation to vegetarian/cultural diets) to support experimentation.

In addition to promoting low-carb in individual consultations, most low-carb practitioners had established support groups, many of which were reported as the

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Table 3 Diverging from established dietary guidelines

Reference No	Interview excerpt
3.01	*I was all the time feeling quite defensive, because of guidelines, because of what Diabetes UK was saying, because of what cardiologists were saying, because of what Public Health England's Eatwell Guide is saying. But […] I had a sort of moral obligation to tell [patients] what I knew. I suppose I tiptoed at first. I said [to patients] 'well you'll find what the guidance is on the Public Health England website [but] this is another way you could try'.* (GP04)
3.02	*They don't get it initially: [they say] 'I've been told brown rice is good for the last 20 years'.* (HC08)
3.03	*I can confidently say 'it's weird, but actually increasing the amount of fat you eat, reducing the carbs, doesn't put your cholesterol up, it actually reduces it, […] it's not the fat that makes you fat (which is the intuitive thing that I believed for decades); it's the carbs that make you fat'.* (GP14)
3.04	*It's usually not too hard a conversation, because I usually say 'has it worked?' And it never has! Kind of an easy-in really, if they want to explore something different.* (GP17)
3.05	*It's very hard to eat addictive things in moderation […] the idea [promoted by food manufacturers and diet companies] that you can have these nice things that you don't want to give up, and it will work—that's a lie.* (GP12)
3.06	*You know, there's always going to be patients who's going to struggle—my patients where their depression just dictates everything. If they're motivated and on top of things, they're doing really well. And then they'll spectacularly fall off the wagon and, because we've stopped some medications, you know, that sort of safety net's gone.* (GP17)
3.07	*I tell them that they can contact me any time […] I'll say 'try it for two weeks, see what happens and we'll discuss it'.* (PN15)
3.08	*It just helps that I'm their GP and I know them really well. […] I have to have a lot of individual conversations about exactly what are people doing.* (GP17)
3.09	*I'm a bit reluctant to send them to [a diabetes education course), there are things about general diabetes that I think they need to learn, but [I say] 'just bear in mind what I'm telling you today might be completely different to what you learn in there.* (PN15)
3.10	*In the last year I've avoided referring people to the dieticians, because they're going to tell them the exact opposite of what I'm telling them.* (GP17)
3.11	*[The low-carb approach] really changed [lifestyle] conversations for me, especially learning a lot about the food industry, really taking away the blame from the patients, and shifting away from this 'eat less, move more' mantra that just doesn't work for people.* (GP17)
3.12	*Healthcare systems are breaking, financially I can't refer a child for a mental health support because we have no money, and yet we can throw money away on a reversible problem. It just, it's wrong in every way, and yet there's a relatively simple solution.* (GP06)

catalyst for significant metabolic health improvements. These group sessions were variously organised, but were usually informal without a standardised format or restrictive eligibility criteria. They enabled presentations of the underpinning science and examples from practice, along with ongoing and flexible peer support among patients (particularly around psychosocial aspects of eating and/or short-term side effects of a low-carb diet). Several practices used Public Health Collaboration's Ambassadors Programme ('Volunteer Health Coaches') to run these groups. Many had been transferred (or initiated) online due to COVID-19 restrictions.

Diverging from established dietary guidelines

Low-carb practitioners were convinced by the scientific evidence supporting low-carb as a first-line intervention, and felt under a moral obligation to share their knowledge about low-carb with patients. However, low-carb practitioners were concerned about tensions between low-carb and more established dietary interventions, which had become embedded in guidelines over the last 40 years. For this reason, some reported 'tiptoeing' when introducing low-carb into clinical practice, being careful about how they navigated healthy eating guidelines (No 3.01), and limiting low-carb advice to patients with type 2 diabetes and/or obesity, for whom the evidence was strongest (see table 3).

Tensions routinely emerged between the low-carb approach and established dietary guidelines such as the Eatwell Guide (No 3.01). For example, low-carb practitioners believed the Eatwell Guide undermined 'real-food' messages with pictures of breakfast cereals, bread, margarine and low-fat dairy products.

Promoting low-carb required that practitioners respond to established dietary knowledge as presented to them by patients (No 3.02). In particular, replacing carbohydrates with dietary fats/protein created particular dissonance (No 3.03). A typical way of handling such queries, HCPs reported, was to question whether previous approaches

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had 'worked' (No 3.04). Low-carb practitioners reported that low-carb was often difficult for patients within a high-carbohydrate food environment in which 'treats' and 'all-things-in-moderation' are encouraged. They reported that some patients who were 'addicted' to carbs/sugar were advised to take a particularly rigorous approach to cutting carbohydrate (No 3.05).

HCPs reported that by following low-carb inconsistently there were risks of medication side effects (No 3.06). Low-carb practitioners talked about relying on closer monitoring than was established within chronic disease management systems to mitigate against clinical harms (and consequent complaints)—for example, from hypoglycaemia, when managing glucose-lowering medications alongside carbohydrate reduction. They described asking patients to communicate directly with them, instead of following usual appointment processes (No 3.07, No 3.08). They reported tensions with some other clinicians and often organised dietary support 'in-house' rather than referring to dietitians—or carefully highlighted differences with other HCPs, in order to reduce confusion for patients (No 3.09, No 3.10). Although low-carb practitioners varied in their willingness to directly criticise established and dominant dietary knowledge, most found that highlighting food/pharmaceutical involvement in the production of evidence/guidelines combated patients' feelings of shame in relation to their inability to make changes (No 3.11). They described frustration with institutional systems (and organisations such as National Institute for Health and Care Excellence) that were seen to resist potentially transformative scientific and practice-based evidence (No 3.12).

DISCUSSION

This study uniquely documents the experiences of a growing movement of HCPs in family practice who are promoting low-carb as a first-line (and superior) treatment for metabolic conditions—especially type 2 diabetes and other conditions involved in metabolic syndrome. We have described this group of HCPs as 'low-carb practitioners', in line with how they self-identified and associated with the low-carb movement of scientists, clinicians, patients and others promoting low-carb for metabolic health improvement. Their shift to promoting low-carb options was apparently driven by their frustration with what they perceived to be ineffectual established interventions and guidance. As a result of this they had sought alternatives from outside the established channels for evidence-based practice and professional development. As front-line primary care HCPs, most low-carb practitioners regretted their lack of training in nutrition.

Low-carb practitioners' accounts challenge dominant contemporary narratives that attribute the ineffectiveness of lifestyle interventions to patients' lack of adherence,[40–42] and/or focus on practitioners' unwillingness to discuss diet/weight.[43] Participants in this study compared low-carb with other approaches that they had recommended previously (eg, Eatwell Guide healthy eating guide, commercial weight loss programmes). Their perception was that for many people previous adherence had not led to improvement in key markers of health—which had discouraged them from proactively addressing diet with patients. These early adopters of low-carb intervention contended that low-carb 'works'—that is, as an evidence-based strategy for self-management—and that they had witnessed improvements in their patients' metabolic health. The findings are consistent with a previous survey of patient experiences of low-carb intervention.[44]

Low-carb practitioners had become highly enthusiastic about initiating conversations about diet with patients and supporting dietary change. This finding is a notable point of difference with other studies that have conversely highlighted that HCPs in family practice tend to *avoid* conversations about diet and exercise with patients because of the perceived sensitivities of discussing lifestyle/weight,[43] as well as institutional factors such as limited nutrition education in clinical curricula,[45] short appointment times[46] and incentives that drive pharmaceutical interventions.[35] Low-carb practitioners reported personally monitoring patients, explaining physiology[47] and discussing the social complexities of everyday eating as part of consultations, in a way they had not undertaken previously.[26] Such care practices are known to be valued by patients,[48] but are increasingly constrained within the severe pressures of UK family practice.

Concerns have been raised over implementation and sustainability of low-carb in patients' everyday self-management practice.[49] In this study, low-carb practitioners reported that they supported patients to incrementally experiment with low-carb eating—encouraging them to be as radical as was manageable in light of their current diet and everyday life, assuring them that health improvement would follow and facilitating active monitoring of improvement in relation key health markers. Practitioners' accounts indicated that, although some patients required only a prompt and minimal clinical intervention, for others more attentive support was required. They noted that patients from a wide range of socioeconomic and cultural backgrounds were able to implement the approach and sustain it over months and years—although with various challenges. Particular attention was required to ensure medication safety when patients made dramatic and/or sudden reductions to their dietary carbohydrates.

The low-carb approach observed in family practice can be defined as a 'complex intervention'[24 29] involving different elements—not only low-carb as a dietary technology (ie, the nutritional profile recommended to patients). Our findings indicate that low-carb practitioners generated positive therapeutic relationships with patients, established models for support (eg, peer support groups, personal email support) and that these changes may have contributed to patients adopting/adhering to broadly defined 'healthy eating' behaviours.[50] Participants, however, contended that the key mechanism for

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impact was the low-carb dietary technology, and that the development of supplementary care practices had been inspired by this low-carb component.

This study foregrounds the importance of social science studies of dietary interventions. It has highlighted the experiences of HCPs who have adopted the low-carb approach, and the transformative impact on practice that they report. This is important experience-based evidence[30] that can inform the development of further research, and ultimately help ensure that patients with markers of poor metabolic health have access to support that meets their needs. Further research on low-carb interventions should involve biomedical studies of clinical effectiveness and harms, and pragmatic, formative process evaluations of how they are being implemented in practice,[29] including the feasibility, appropriateness and meaningfulness of intervention.[51] It should explore different models of support, including the various technologies and care practices involved (eg, blood glucose monitoring systems; peer support groups; educational materials and messaging; and online/digital support).

Crucially, further research should map different forms of knowledge about diet and nutrition, sources of evidence and how low-carb fits (or does not fit) within the broader institutional structures delivering dietary support. It should ensure that the experiences of a wide range of different stakeholders are captured—including people with different conditions, from different sociodemographic backgrounds and those that have resisted or struggled with the approach. The 'shadowed data' reported here (experiences of patients, as reported by practitioners[32]) also point to other important avenues for further investigation (eg, dietary 'habits', carb 'addiction', disordered eating[52]) that may help address persistent questions about sustainability of low-carb eating and potential harms of low-carb when implemented in everyday life.[53]

STRENGTHS AND LIMITATIONS

This study uniquely documents the perceptions and experiences of low-carb practitioners in family practice, including reported improvements in patients' metabolic markers. It reports low-carb practitioners' own *accounts* of their practices, and does not attempt to externally verify their experiences, or address quantitative outcomes of low-carb interventions—despite many participants sharing statistics from their own records in interviews. The findings reported here are predominantly from GP interviews, reflecting the data sample, and the dominance of GPs among early adopters of low-carb interventions in family practice.

CONCLUSIONS

In the context of controversies around how the scientific evidence base for dietary intervention can be interpreted and applied, this study provides important experience-based evidence on a topical dietary intervention. Low-carb practitioners strongly advocated for the use of low-carb diets in the management of people with type 2 diabetes and related metabolic conditions. The successes described draw attention to the need for pragmatic, formative evaluation of low-carb as a 'complex intervention' (alongside physiological research), to justify, challenge and/or shape low-carb intervention in clinical practice. Social science analyses would elucidate how this intervention is carried out across different healthcare settings (eg, dietetics, endocrinology) and patient groups, how healthcare practices intersect with people's everyday self-management and how different forms of evidence are invoked and prioritised.

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